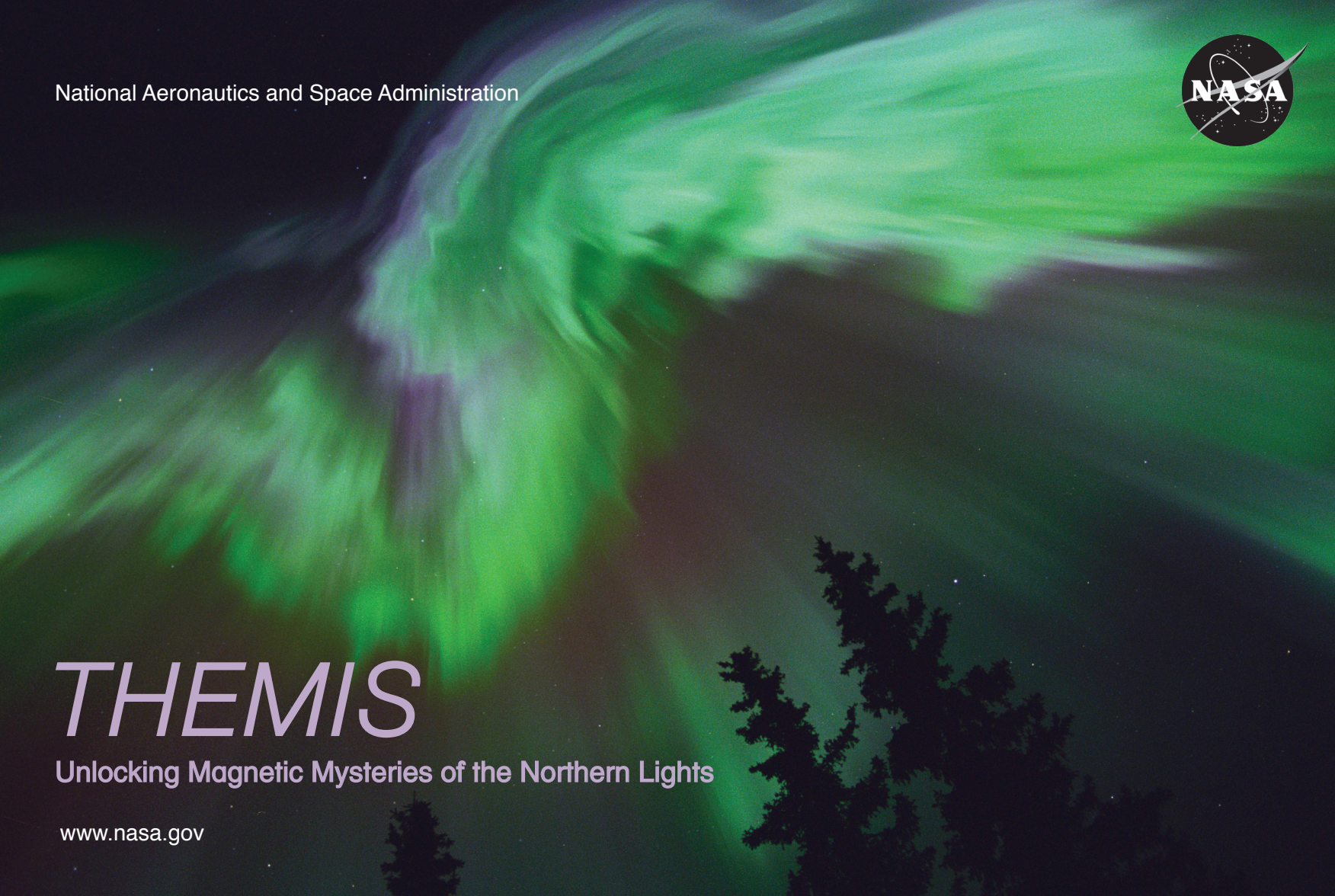


National Aeronautics and Space Administration

THEMIS

Unlocking Magnetic Mysteries of the Northern Lights

www.nasa.gov

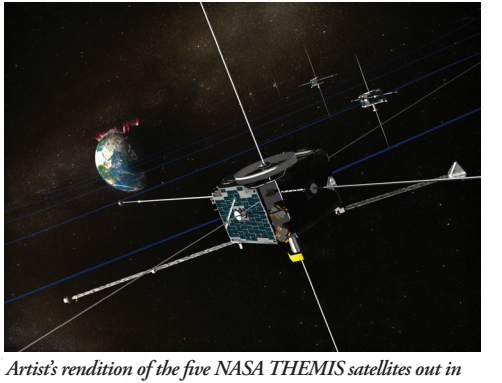
Unlocking Magnetic Mysteries of the Northern Lights

For over 400 years, we've understood that the Earth's magnetic field is like that of a giant bar magnet. Compasses align with Earth's field, pointing north to the magnetic pole in northern Canada. With the dawn of the space age, spacecraft observations and mathematical models confirmed speculations that the Earth's magnetic field forms a bubble in space known as the *magnetosphere,* which shields us from the supersonic *solar wind* streaming out from the Sun. The solar wind compresses the magnetosphere on the side of the Earth facing the Sun, and stretches it out into a long magnetic tail—just like an airport windsock—on the side opposite the Sun. Scientists have also known for over 100 years that auroras are caused by electric currents. About fifty years ago it was discovered that the currents were carried by particles within this "magnetic windsock." The particles move along magnetic lines of force towards Earth's magnetic poles, gaining speed in a region about 2,000 km above Earth's surface. They then collide with Earth's upper atmosphere, causing it to glow, at an altitude between 100-200 km. The glowing lights are the Northern (and Southern) Lights, or *auroras*. They appear to us as luminous bands of green and white stretching across the night sky—but viewed from space, you see that they actually form oval bands around each of Earth's two magnetic poles. The auroral ovals sometimes radically increase in brightness, width and size, up to several times in one day. This change is related to processes in Earth's magnetosphere, collectively known as a *substorm*.

Front photo by Jan Curtis

THEMIS is named after the Greek goddess of justice. NASA's THEMIS mission seeks to determine, without bias, the correct scientific model of substorm onset.

The NASA THEMIS mission continues scientific discovery about the complex relationship between auroras and Earth's magnetosphere. In 2007, five satellites were placed in orbit around Earth; twenty ground-based observatories were deployed in Canada and Alaska, and ten instruments, or *magnetometers*, were placed at US schools to measure magnetic fields. The data from all these scientific instruments have revealed the timing of events during a substorm. For the first time, the five satellites were aligned in just the right place and at just the right time—and in the right relationship with the ground-based instruments—to help unlock this mystery. THEMIS discovered that during *substorm onset* (an event rather like the onset of an earthquake) energy was very quickly released far out in Earth's *magnetotail*—a third of the way to the Moon's orbit. This energy release process, known as *magnetic reconnection*, set off a chain of events in the magnetotail, leading to a beautiful eruption in the normally calm aurora. On Earth, you would have seen the tranquil auroral glow change to a wild dance of ribbons and curtains of light in the sky.



Artist's rendition of the five NASA THEMIS satellites out in space in Earth's magnetotail . You can see the aurora shining brightly above Earth's surface. (By GSFC Visualization Lab.)

Learn more about these mysteries and discoveries at the THEMIS website: http://ds9.ssl.berkeley.edu/themis